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A Winter Survey of Oxygen Distribution in
Long Island Sound and Block Island Sound.
Cruise STIMI-III, January-February 1952.

By

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The data in this report were obtained during January 1952 on Cruise STIMI-III of the project. Oxygen samples were obtained at fifty-three stations. Of these, twenty-three stations were located in Block Island Sound and thirty were in Long Island Sound. The positions of those stations as well as the locations of the vertical sections (Figures 3A through 3E) are presented in Figure 2. The four westernmost stations in Long Island Sound were occupied with respect to tidal times: at slack before ebb, and at slack before flood. This was done to determine the tidal displacement of the surface parameters, salinity, temperature, and oxygen.

The modified inler method was used to analyze the samples for oxygen content immediately after they were obtained. The oxygen per cent saturation was computed from Killo's nomograph (1936).

OXIDATION

Surface oxygen values show an overall progressive increase from 6.6 ml/l and 24 per cent saturation in southeastern Block Island Sound to values greater than 7.9 ml/l and 99 percent saturation in the most central area of Long Island Sound (Figures 1A and 1B). A decided drop in surface oxygen values occurs in the extratropical western portion of Long Island Sound. Subsurface values show a similar distributional pattern. A detailed description of the more salient features of winter oxygen distribution follows:

Block Island Sound: The lowest surface values (6.6 to 6.9 ml/l) are found in the region between Montauk Point and Block Island. Proceeding westward, the oxygen content increases progressively until a maximum of 7.7 ml/l is reached in Gardiners Bay (Figure 1A).

The vertical distribution of oxygen in milliliters per liter in Block Island Sound is shown in Figures 3A and 5A. The subsurface water increases in oxygen content from less than 6.6 ml/l in the southeastern part of the sound to greater than 7.2 ml/l at the western end. It is also shown that the oxygen content is either uniform from top to bottom or shows a decrease of not more than 0.4 ml/l in approximately thirty-five meters of depth (Section III-I). The highest subsurface values in Block Island Sound are found in Gardiners Bay and range from 7.5 to 7.8 ml/l (Section IV-I). The lowest subsurface values are found between Montauk Point and Block Island where a minimum of 6.4 ml/l occurs (Section II-II).

Surface water with the greatest per cent saturation (98%) occurs as a tongue between Block Island and Point Judith (Figure 1D). The least saturated water is found as a tongue of 94% between Montauk Point and Block Island. In general, the northern portion of the Sound shows a progressive, but small, westward decrease in saturation from 98 per cent north of Block Island to less than 95 per cent south and east of the Neck. The middle and southern portions show a decrease in saturation from 97 percent around the western side of Block Island to less than 95 per cent in the region between Montauk Point and Watch Hill Point. From here, values increase again to greater than 97 per cent in Cardinale Bay.

Figures 3D and 5D indicate that the vertical variation does not exceed three per cent in Block Island Sound (Section IJK). Except between Block Island and Point Judith, subsurface values are consistently lower in the northern portion of the Sound than in the middle and southern regions.

Long Island Sound: Surface water with the highest oxygen content occurs in the west central portion of the Sound with values ranging from 7.7 ml/l to a high of 7.9 ml/l in Smithtown Bay (Figure 1A). The extreme western end of the Sound which is under the tidal influence of the East River reaches a low of 6.2 ml/l at slack before ebb and 6.9 ml/l at slack before flood. Values in the eastern end of the Sound range from 7.0 ml/l along the north shore near the mouth of the Connecticut River to 7.5 ml/l along the opposing southern shore.

The vertical distribution of oxygen in milliliters per liter in Long

Island Sound is shown in Figures 4A and 5A. These sections show the oxygen content to be nearly uniform from top to bottom. Subsurface values (7.4 to 7.6 ml/l) found in the region of the Housatonic River (Section H-H') are lower than those at the surface. In general, the subsurface water in the northern part of the Sound has slightly less oxygen than does that along the southern shore. It should be noted that Sections S-S', which compare slack before ebb with slack before flood, in the westernmost part of the Sound have slightly higher values on the northern side of the Sound than on the southern side. This constitutes a reversal of the pattern which has been exhibited in the other areas of the Sound. It is discussed below.

In Figure 1A the contours in the extreme western end of the Sound at slack before flood contain two inversions. Reading westward from the dashed line between "Tidalocs" and "Slack before flood" the contours are 7.6, 7.5, 7.4, <7.4, 7.4, 7.5, >7.5 in the area indicated by the label, thence decreasing westward to 6.9 at Clason Point in the Upper West River. Section S-S' at slack before flood cuts across the first of these inversions. At slack before ebb two inversions are again present. Reading westward from the dashed line the contour values are: 7.6, <7.6, 7.6, >7.6 at the place indicated by the label; thence decreasing westward to 6.2 off Clason Point.

The surface pattern of oxygen saturation in Long Island Sound (Figure 1B) closely resembles that shown by oxygen content in milliliters per liter. The least saturated water is found off Clason Point in the

Upper East River. Here a minimum value of 77 per cent is found at slack before ebb, while the lowest at slack before flood is 86 per cent. Water of comparatively low saturation (92-94%) extends from around the mouth of the Connecticut River westward to the Housatonic River. Water of highest saturation, 97 to 99 per cent, is found in the west central and southern regions of the Sound.

The vertical sections in Figure 4B and 5C show nearly uniform saturation values from top to bottom; water along the north shore being somewhat less saturated than that along the south shore except in the extreme western end (Section Q-Q'). The difference is most apparent in section L-L' where the values range from 92 per cent to greater than 96 per cent, and in section M-M' (92 per cent to 98 per cent). The variation from the north to south shore decreases in magnitude as one proceeds westward, until in the region of Section P-P' water of nearly the same per cent saturation is found along both shores. Further westward in the extreme end of the Sound a reversal of the above pattern occurs, more saturated water being present in the northern portion and less saturated in the southern.

DISCUSSION

The nearly uniform vertical distribution of oxygen throughout Long Island Sound and Block Island Sound is to be expected in January. This homogeneous distribution is largely attributable to the mixing effect of the winds at this time of the year.

The lower oxygen values found between Montauk Point and Block Island

are probably a reflection of the winter, more saline offshore water carried into that area by the flood tide (Status Reports Nos. 21 and 22). The decrease in temperature and salinity from the eastern to the western end of the sound in all probability accounts for the general east to west increase in oxygen content. Local lowered oxygen values appear to be attributable to pollution.

The higher oxygen content of the water in Gardiners Bay is very likely due to the unpolluted, colder, less saline water present in the area.

Although the water along the northern shore of Block Island Sound west of 72°40'W is less saline and colder than that north of Block Island (Status Reports No. 21 and 22), the oxygen per cent saturation is found to be less. This is perhaps caused by the factors mentioned below which are believed responsible for the oxygen picture in Long Island Sound.

The lower oxygen content in the northern portion of Long Island Sound in the vicinity of the Connecticut River's mouth seems to be attributable to upwelling in that area under the influence of the S.E. winds which prevailed at the time of the survey. These winds appear to have moved the lighter surface water offshore and to seaward allowing upwelling of subsurface water of lower oxygen content. Whether or not pollution from the Connecticut River contributed to the reduced oxygen values in this area is not known. The low oxygen values in the central western area of Long Island Sound are apparently to a result of wind-induced not river pollutants.

Pilay (1952) states that a counterclockwise movement of surface water tends to be present in Long Island Sound and is initiated by fresh water drainage. The present data also indicate its presence. The westward extension of water of lower oxygen content in the north central portion of the Sound and the eastward extension of higher values along the southern shore indicate counterclockwise movement. The low oxygen values along the southern shore in the eastern western end of the Sound indicate that the polluted est river water has a net or non-tidal movement eastward along the south shore; the oxygen-reducing effect of these pollutants seems to disappear by the time they reach Eaton's Neck where reduced oxygen values grade into high oxygen values. This is interpreted as evidence of regeneration of plant nutrients from the pollutants, followed by increased phytoplankton photosynthesis. Increased transparency of the water (Status Report No. 13) and eastward extension of brown-green water (Status Report No. 14) along the south shore support this view.

In central Long Island Sound between $72^{\circ}20'$ and $72^{\circ}45'$ the contours of 7.4 and 7.5 ml/l bulge southward and 7.6 ml/l bulges eastward. This area is difficult to interpret from oxygen data alone. However, it should be noted that the oxygen distribution here and in other parts of the Sound are in good agreement with the current pattern shown by Pilay (1952).

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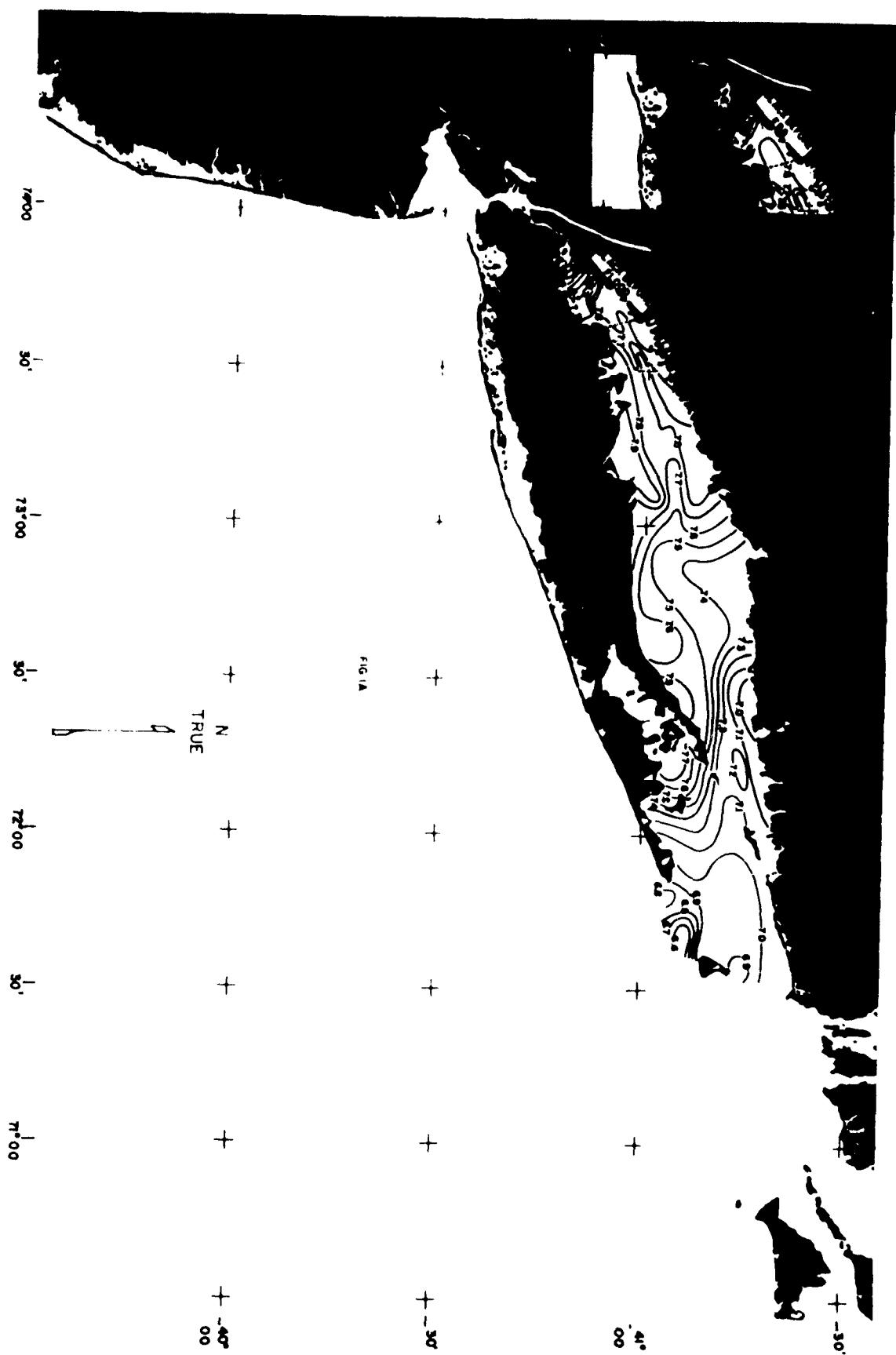
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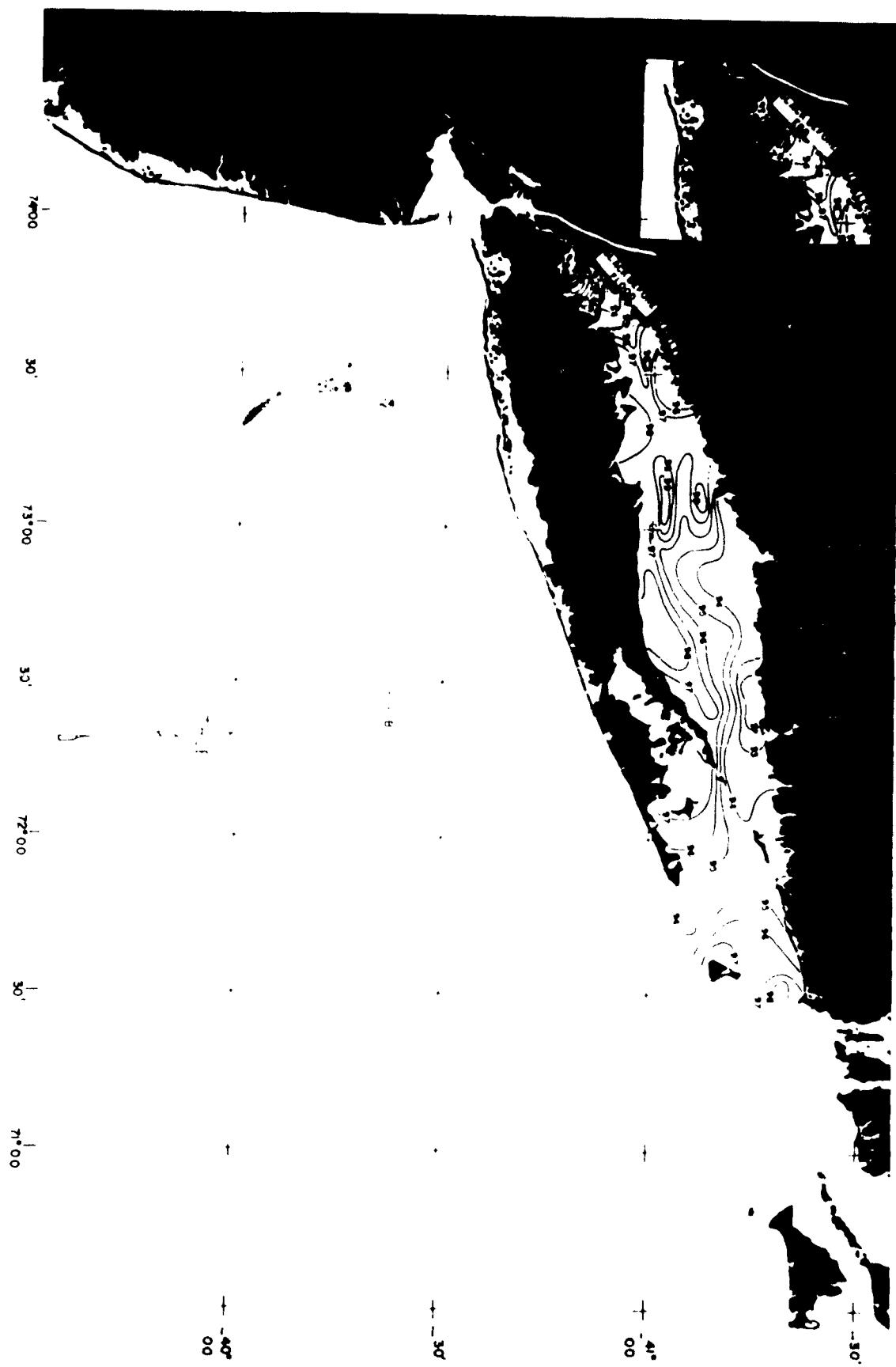
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Figure 1A. Surface Oxygen, milliliters per liter, in Block Island Sound and Long Island Sound, Cruises ST-II-III, January-February, 1952.



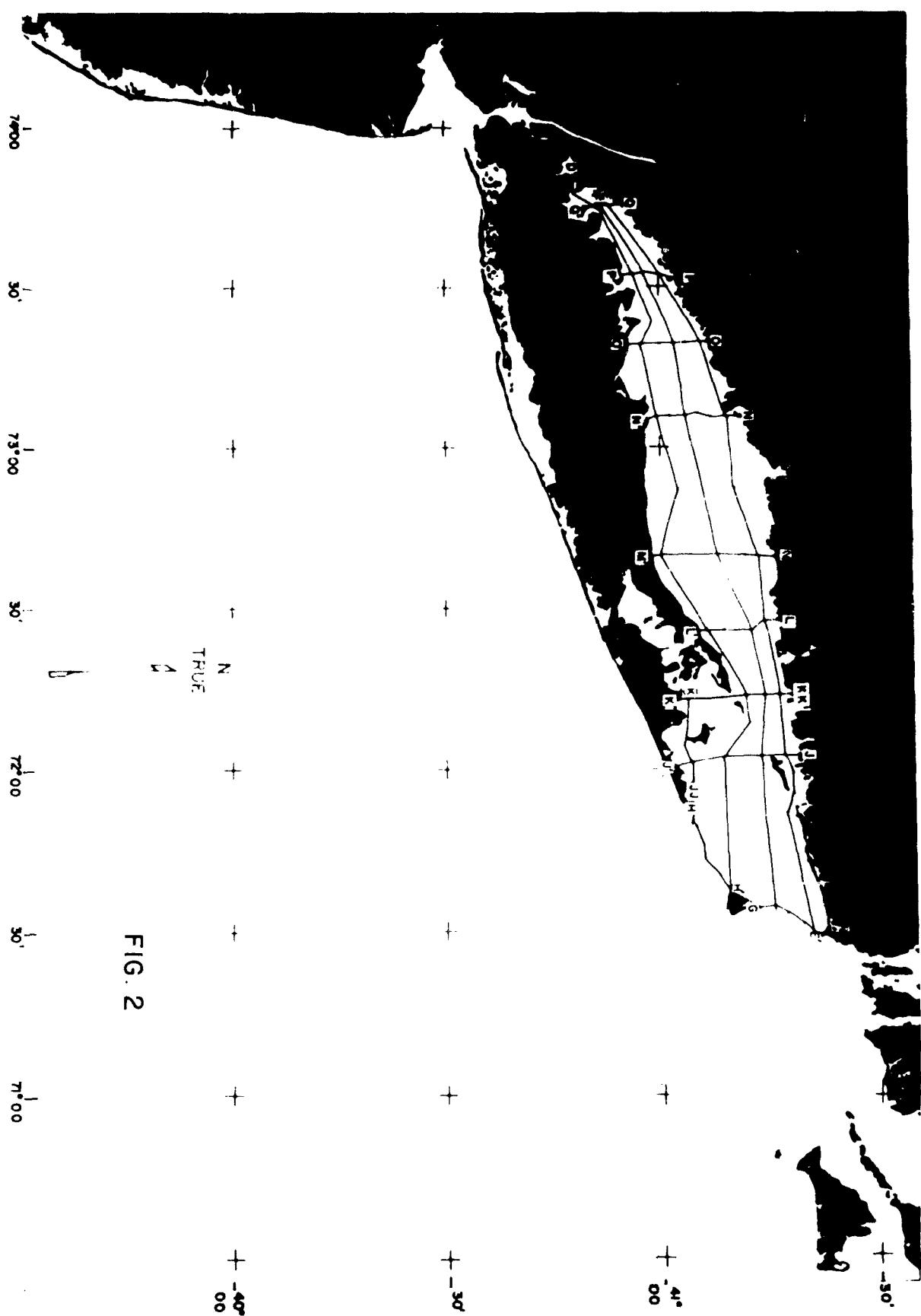
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Figure 1. Surface water, per cent saturation, in Long Island Sound and Block Island Sound, Service SPK I-III, January-February, 1952.



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Figure 6. Location of catchers and vertical sections in Long Island Sound and Block Island Sound, Grids 5751-5752, January-February, 1950.



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Figure 3A. Vertical Distribution of oxygen, milliliters per liter, in Block Island Sound, Cruise SPLIT-III, January-February, 1952.

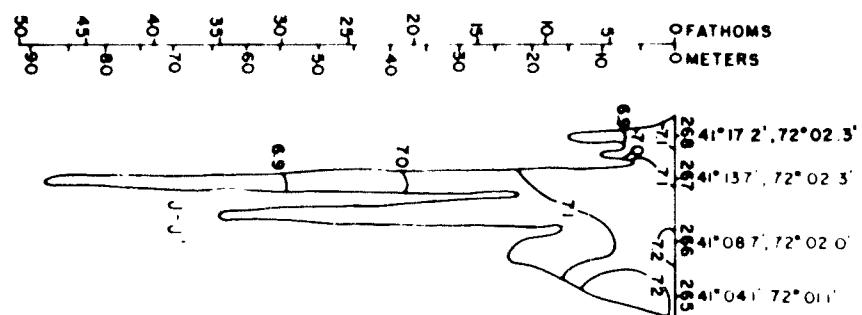
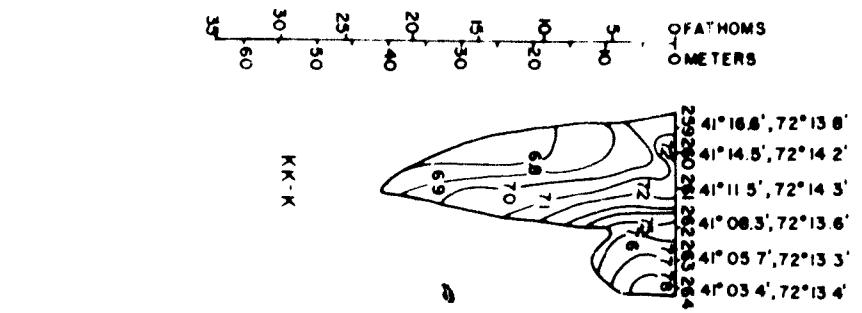
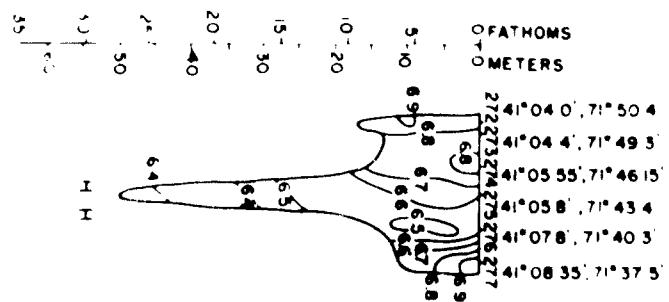
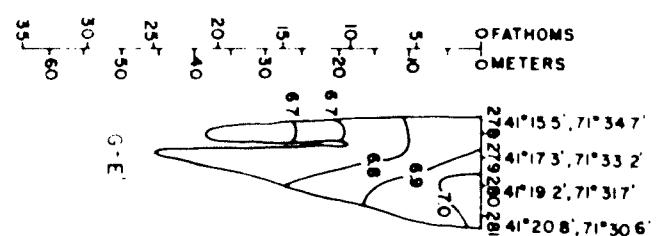


FIG 3A



Legend

Figure 3D. Vertical Distribution of Crayon, per cent saturation, in
Block Island Sound, Cruise JAH I-III, January-February, 1950.

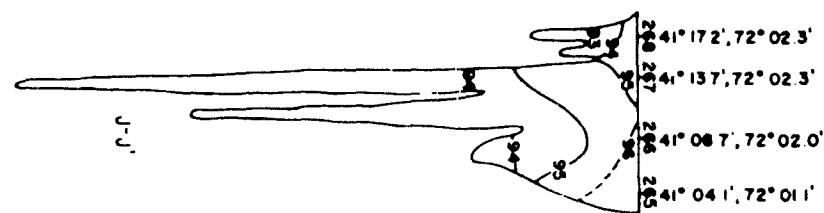
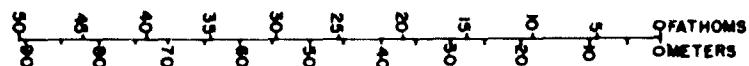
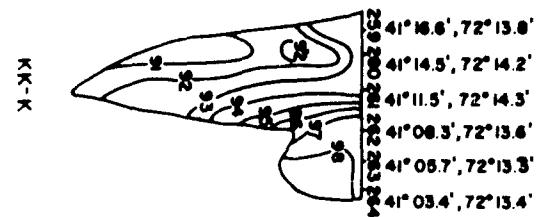
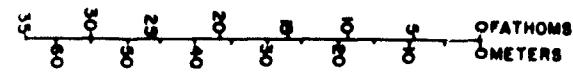
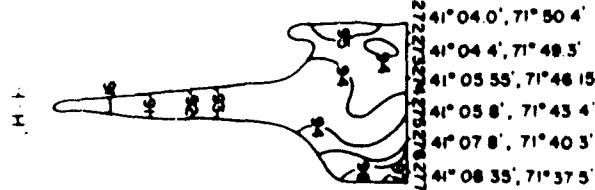
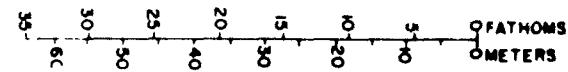
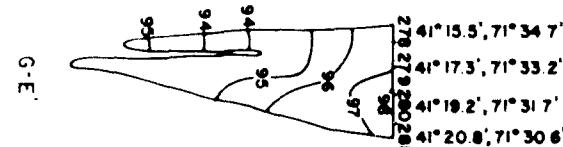
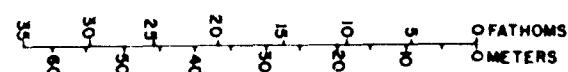
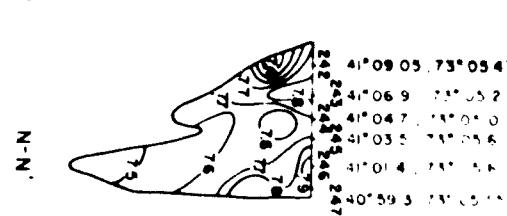
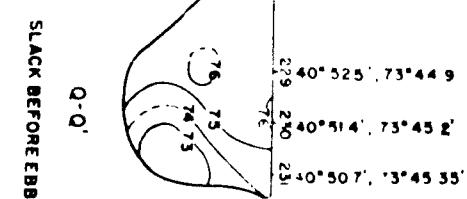
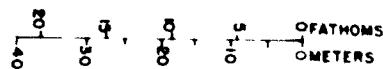
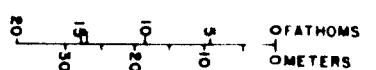
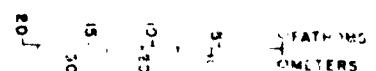
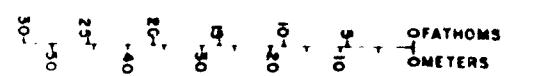
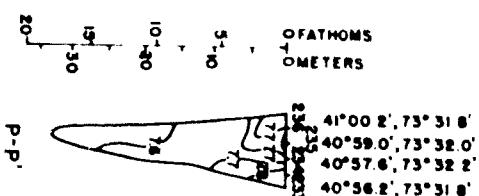
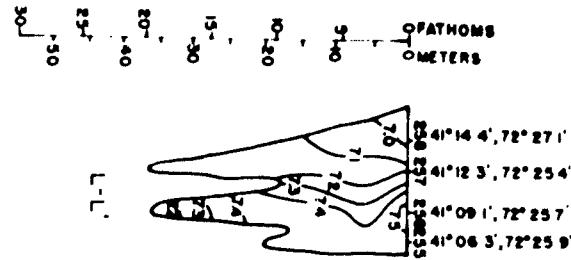
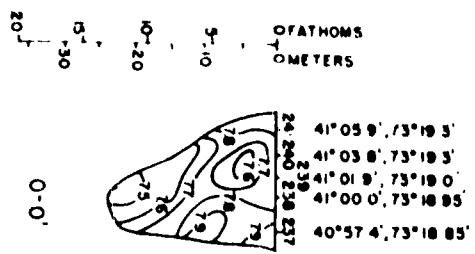


FIG 3B



Legend

Figure 4. Vertical distribution of NO_x (milligrams per liter), in Long Island Sound, April 1952, (continued); 1953.



Legend

Figure 42. Vertical Distribution of oxygen, per cent saturation, in Long Island Sound, device SPHM-III, January-February, 1952.

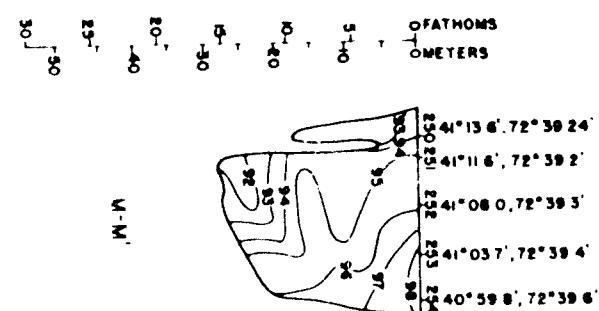
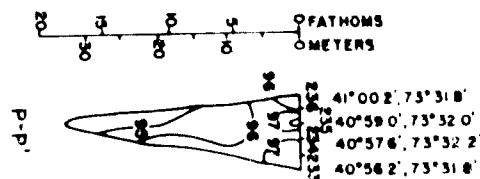
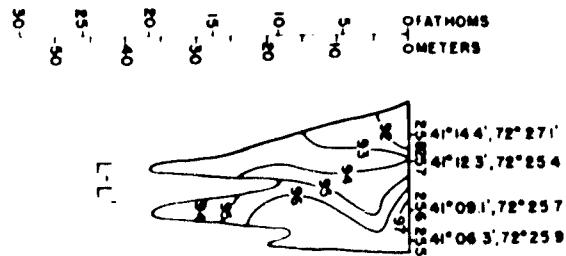
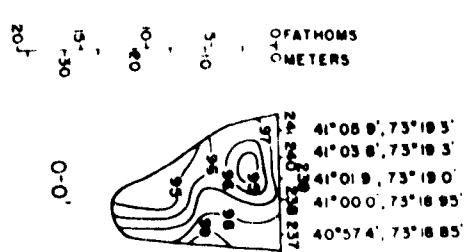
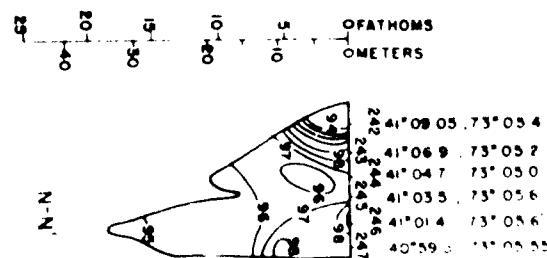
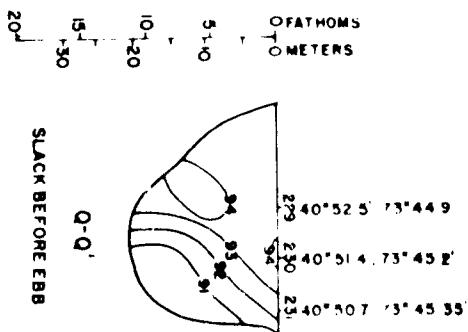
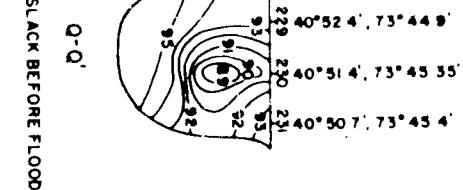
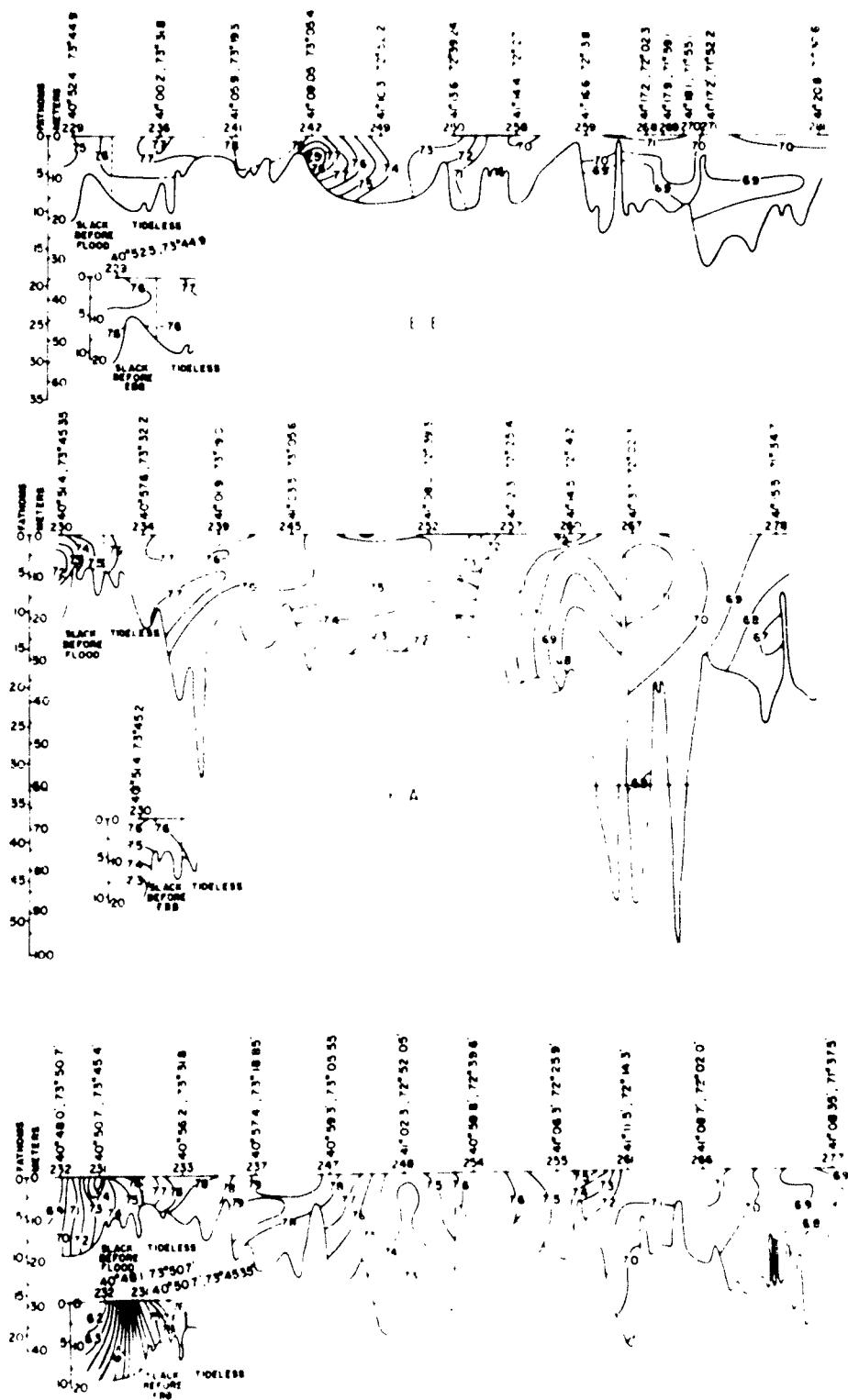


FIG. 4B



Legend

Figure 5A. Longitudinal vs. Siedl Distribution of SO_4^{2-} , milligrams per liter, profiled & reduced from Block Island core and Long Island sound, surface STMT-III, January-February, 1959.



Levend

Figure 5. - Lenitinal ventral testis of *Leucostethus* per cent
and *viridis*, *viridis* with testis 1.60 and *viridis* testis
1.50 mm. *viridis* testis 1.50 mm. *viridis* testis, 1.50.

